

## WHAT IS CLAIMED IS:

1        1.    A radio frequency (RF) down/up-conversion circuit  
2 comprising:

3            a local oscillator chopping circuit comprising:

4                a frequency divider circuit capable of receiving  
5                a first local oscillator (LO) signal having a frequency of  
6                LO and generating therefrom a frequency-divided second  
7                local oscillator (LO) signal having a frequency of LO/N and  
8                synchronized with said first LO signal; and

9                a multiplier capable of receiving said first and  
10                second LO signals and generating a product signal of said  
11                first and second LO signals; and

12                a differential radio frequency (RF) mixer having a  
13                first differential input port capable of receiving said product  
14                signal from said multiplier and a second differential input port  
15                capable of receiving a first differential modulated radio  
16                frequency (RF) signal and a second differential modulated radio  
17                frequency (RF) signal, wherein said differential RF mixer  
18                generates a differential output signal.

1        2.    The radio frequency down/up-conversion circuit as set  
2 forth in Claim 1 wherein said multiplier is an analog multiplier.

1           3.    The radio frequency down/up-conversion circuit as set  
2   forth in Claim 1 wherein said multiplier is an exclusive-OR gate.

1           4.    The radio frequency down/up-conversion circuit as set  
2   forth in Claim 1 wherein said differential output signal of said  
3   differential RF mixer is a double-sideband suppressed carrier  
4   signal.

1           5.    The radio frequency down/up-conversion circuit as set  
2   forth in Claim 4 further comprising a chopping switch capable of  
3   receiving said differential output signal of said differential RF  
4   mixer.

1           6.    The radio frequency down/up-conversion circuit as set  
2   forth in Claim 5 wherein said chopping switch is synchronized to  
3   said frequency divider such that said switching switch switches  
4   its internal connections at said LO/N frequency of said frequency  
5   divider and in tandem with said frequency divider.

1        7.    The radio frequency down/up-conversion circuit as set  
2    forth in Claim 1 wherein said differential RF mixer comprises a  
3    first differential pair of transistors comprising a first  
4    transistor and a second transistor, wherein a base of said first  
5    transistor is coupled to a first differential output signal  
6    received from said multiplier, and an emitter of said first  
7    transistor is coupled to an emitter of said second transistor and  
8    to said first differential modulated radio frequency (RF) signal.

1        8.    The radio frequency down/up-conversion circuit as set  
2    forth in Claim 7 wherein said differential RF mixer comprises a  
3    second differential pair of transistors comprising a third  
4    transistor and a fourth transistor, wherein a base of said third  
5    transistor is coupled to a second differential output signal  
6    received from said multiplier, and an emitter of said third  
7    transistor is coupled to an emitter of said fourth transistor and  
8    to said second differential modulated radio frequency (RF)  
9    signal.

1        9.    The radio frequency down/up-conversion circuit as set  
2    forth in Claim 8 wherein a collector of said first transistor is  
3    coupled to a collector of said third transistor to form a first  
4    differential output signal of said differential output signal  
5    generated by said RF mixer and wherein a collector of said second  
6    transistor is coupled to a collector of said fourth transistor to  
7    form a second differential output signal of said differential  
8    output signal generated by said RF mixer.

10. A radio frequency (RF) receiver comprising:

a receiver front-end circuit capable of receiving an incoming RF signal from an antenna and filtering and amplifying said incoming RF signal; and

a radio frequency (RF) down/up-conversion circuit coupled to said receiver front-end circuit comprising:

a local oscillator chopping circuit comprising:

a frequency divider circuit capable of receiving a first local oscillator (LO) signal having a frequency of LO and generating therefrom a frequency-divided second local oscillator (LO) signal having a frequency of LO/N and synchronized with said first LO signal; and

a multiplier capable of receiving said first and second LO signals and generating a product signal of said first and second LO signals; and

a differential radio frequency (RF) mixer having a first differential input port capable of receiving said product signal from said multiplier and a second differential input port capable of receiving a first differential modulated radio frequency (RF) signal and a second differential modulated radio frequency (RF) signal, wherein said differential RF mixer generates a differential output signal.

1           11. The radio frequency receiver as set forth in Claim 10  
2 wherein said multiplier is an analog multiplier.

1           12. The radio frequency receiver as set forth in Claim 10  
2 wherein said multiplier is an exclusive-OR gate.

1           13. The radio frequency receiver as set forth in Claim 10  
2 wherein said differential output signal of said differential RF  
3 mixer is a double-sideband suppressed carrier signal.

1           14. The radio frequency receiver as set forth in Claim 13  
2 further comprising a chopping switch capable of receiving said  
3 differential output signal of said differential RF mixer.

1           15. The radio frequency receiver as set forth in Claim 14  
2 wherein said chopping switch is synchronized to said frequency  
3 divider such that said switching switch switches its internal  
4 connections at said LO/N frequency of said frequency divider and  
5 in tandem with said frequency divider.

1        16. The radio frequency receiver as set forth in Claim 10  
2 wherein said differential RF mixer comprises a first differential  
3 pair of transistors comprising a first transistor and a second  
4 transistor, wherein a base of said first transistor is coupled to  
5 a first differential output signal received from said multiplier,  
6 and an emitter of said first transistor is coupled to an emitter  
7 of said second transistor and to said first differential  
8 modulated radio frequency (RF) signal.

1        17. The radio frequency receiver as set forth in Claim 16  
2 wherein said differential RF mixer comprises a second  
3 differential pair of transistors comprising a third transistor  
4 and a fourth transistor, wherein a base of said third transistor  
5 is coupled to a second differential output signal received from  
6 said multiplier, and an emitter of said third transistor is  
7 coupled to an emitter of said fourth transistor and to said  
8 second differential modulated radio frequency (RF) signal.

1        18. The radio frequency receiver as set forth in Claim 17  
2 wherein a collector of said first transistor is coupled to a  
3 collector of said third transistor to form a first differential  
4 output signal of said differential output signal generated by  
5 said RF mixer and wherein a collector of said second transistor  
6 is coupled to a collector of said fourth transistor to form a  
7 second differential output signal of said differential output  
8 signal generated by said RF mixer.



1        19. A method of demodulating an incoming differential radio  
2 frequency (RF) signal having a frequency of RF comprising the  
3 steps of:

4                receiving a first local oscillator (LO) signal having a  
5 frequency of LO;

6                generating therefrom a frequency-divided second local  
7 oscillator (LO) signal having a frequency of  $LO/N$  and  
8 synchronized with the first LO signal;

9                multiplying the first and second LO signals and  
10 generating a product signal of the first and second LO signals;  
11 and

12                mixing the product signal from the multiplier and the  
13 differential radio frequency signal and generating a differential  
14 output signal.

15  
16        20. The method as set forth in Claim 19 wherein the  
17 differential output signal is a double-sideband suppressed  
18 carrier signal.